Pediatric Cochlear Implantation: Candidate Evaluation

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The Cochlear Implantation Team

- Interdisciplinary team
  - Otologist
  - Audiologist
  - Aural rehabilitation specialist
  - Speech pathologist
  - Clinical psychologist

Cochlear Implant Candidate Selection

- Audiologic Criteria
- Age
- Absence of Medical / Radiologic contraindications
- Mode of communication / educational environment
- Individual and family motivation

Pediatric Bilateral Sensorineural Hearing Loss

- Incidence: 1:2000 at birth, 6:1000 by age 18.[1]
- 75% due to known causes
  - Inner ear defects
  - Prenatal insult
  - TORCH infections
  - Meningitis
  - Chronic Otitis Media

Evolving Audiologic Criteria

- May, 1995 NIH Consensus Development Conference on Cochlear Implants.
- **Profound** bilateral sensorineural hearing loss (>90dB)
- Minimal speech perception under best aided conditions.

- April, 2001: Balkany T, et al: Cochlear Implants in Children.*Otolaryngologic Clinics of North America* 34:455-62.
- **Severe** (70-90dB) **or profound** bilateral sensorineural hearing loss
- Those with some residual amplified hearing are still candidates

Audiologic Evaluation

- Necessary to obtain ear-specific auditory information in aided and unaided conditions
  - Complete evaluation may require repeat visits to implant audiologist
  - Trial of amplification adjustment over several months

Expanding Age Criteria

- 1995 NIH Conference:
- Minimum age of *2 years*
- 2001 Balkany, et al.
- Recommend minimum age to be *12 months*.
  - Provides child with auditory input during critical period of language development

Age Criteria

- Younger age at implantation is generally associated with better outcomes.[3]
- Children implanted after age 5 show improvement over those with hearing aids, but less improvement than children implanted under age 5.
- Children over age 10 should be screened carefully, as they are more likely to have poorer outcomes.

Radiologic Evaluation

- Computed tomography of the temporal bones
  - Mastoid aeration
  - Facial nerve position
  - Patency of cochlea
  - Middle ear status
  - Evaluate IAC

Radiologic Evaluation

- Indications for Magnetic Resonance Imaging
  - IAC <1.5mm on CT
    - Evaluate presence of cochlear nerve
  - Hx of Meningitic Deafness
    - Evaluate degree of cochlear ossification
- Cochlear aplasia or auditory nerve aplasia are contraindications to cochlear implantation

Medical Evaluation

- Assess child's overall health
- Evaluate ability to undergo general anesthesia

Mode of Communication

- Oral / aural communication mode at home and in the educational setting is associated with better postoperative speech perception abilities when compared to manual or total communication mode.[2]

Psychosocial Factors

- Patient and family motivation are critical
- Must be prepared for extensive period of aural rehabilitation
  - Initial postoperative rehabilitation may require daily sessions for up to two weeks.
- Realistic expectations

Cochlear Implantation Procedure

- 2-3 hours under general anesthesia
- Patient usually discharged the following day
- Device is activated 4 weeks later

Complications

- Surgical complications - overall <3% [5]
  - Skin flap-related problems: 2.8%
  - Facial nerve injury: 0.2%
  - Electrode migration: 1.2%

- Nonsurgical complications
  - Device failure : up to 10% in some series*
  - Delayed stimulation

  - *Luetje et al. *Otolar-HNS*. 117(3), 243. 1997.

Implant Programming

- Can begin intraoperatively using EABR to confirm auditory stimulation.
- Maximum and minimum stimulation levels are adjusted using behavioral responses, usually 4-6 weeks after implantation
- Programming in young children can be facilitated by more objective measures
  - Telemetry in newer implants

Post-implant performance evaluation:

- Hearing:
  - Sound detection
  - Speech perception
    - Closed set word recognition
    - Open set word recognition
- Language development
- Speech production

Cochlear Implantation Outcomes

- Postlingually deaf children
- Prelingually deaf children
  - Congenital
  - Acquired Meningitic

Outcome in Postlingually Deaf Children

- Dramatic improvement in all perceptual tests, including sound-only open set word recognition, as early as 6 months post-implantation.[3]
- Attributed to advantage of previous hearing

Outcome in Prelingually Deaf Children

- Able to develop speech perception skills equivalent to postlingually deaf patients, but over a longer, more protracted course. [4]
- 80% achieved open set, sound-only word understanding 4 years following implantation.

Language and Speech Development

- Implanted children learn language at a similar rate to their hearing peers, but retain the relative delay present at the time of implantation.[3]
- Auditory input results in improved vocalization quality. Speech of implanted children has shown continued improvement beyond 5 years. [3]

Overview

- Optimal age is 12 months to 5 years.
- Bilateral severe to profound SNHL
- No significant improvement with careful evaluation and adjustment of hearing aids
- Intact cochlear nerve
- Parents and child prepared for intensive rehab.
- Children who are prelingually deaf take longer to show improvement

References

- [1] Billings K. Causes of Pediatric SNHL. *Arch Otolar HNS*. 1999;125:517-21.
- [2] Hodges AV. Speech perception results in children with cochlear implants. *Oto - HNS* 121:31-4, 1999.
- [3] Balkany TJ. Cochlear implants in children. *Oto Clin NA* 34(2); April 2001.
- [4] Wetmore RF. Pediatric Otolaryngology. Thieme Publishers, NY, 2000, p. 359-69.
- 5 Luetje CM. Cochlear implants in children: complications. *Oto - HNS* 1997;117:243-7.